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Description

This invention relates to light emitting devices, such as Laser Diodes (LDs) or others; photodetecting devices, such as PIN Photo Diodes (PINPDs), Avalanche Photo Diode (APD) or others;an optical electric integrated circuits(OEICs) which integrate optical active devices, such as LDs, LEDs, PINPDs, APDs, etc. and electric devices, such as amplifiers, drivers, FETs and others.

Conventionally in, e.g., light emitting devices for this use, various devices have been made for the purpose of collecting radiation from diode chips by lenses or other means to improve the coupling efficiency to optical fibers or others, and the precision of aligning optical axes with those of the optical fibers or others.

The light emitting device of FIG. 15A (Japanese Patent Laid-Open Publication No. 139367/1987) comprises a diode chip 62 mounted on a can-type package 61, and a spherical lens 62 adhered to a light emitting surface 62a of this chip 62. The package 61 is sealed by a glass cap 64. The light emitting device of FIG. 15B includes another ball lens 66 attached to the center of the cap 64. The cap 65 is adhered to the package 61 to seal the chip 62 air-tightly to thereby make up a lens system on the optical axis of the chip 62.

The light emitting device of FIG. 16 Japanese Patent Laid-Open Publication No. 139367/1987) comprises a stem 72 with a diode chip 71 mounted on, and a plastic cap 73 adhered to the stem 72 for air-tight sealing of the diode chip 71. A spherical chip coat 74 is applied to the side of the light emitting surface 71a of the diode chip 71, while an emission surface 73a of the plastic cap 73 is formed in a lens-shape to make up a lens system

FIG. 17 (Japanese Patent Laid Open Publication No. 88377/1987) shows the conventional LED collimator (light emitting diode) for aligning optical axis with that of an optical fiber with high precision. This collimator comprises a stem 82 with a light emitting diode 81 mounted on, a stepped sleeve 83 adhered to the stem 82 for sealing the light emitting diode 81. In this stepped sleeve 83, a ball lens 84 at the middle portion thereof, and a restricted portion 85 is disposed on the front thereof. In this restricted portion 85 is fixedly inserted an optical fiber F.

FIG. 18 (Japanese Patent Laid-Open Publication No. 73786/87) shows the conventional light emitting device for enhancing the coupling efficiency with optical fibers.

This light emitting device comprises a frame 91 having the head 92 made of metal, such as aluminum, or others. A concave groove 92a is formed in the middle of the head 92. A light emitting diode 93 is rested in the concave groove 92a. The concave groove 92a has the wall formed in a curved surface. This curved face is a reflection surface 92b. These members are integrated by resin molding. Consequently diagonally horizontally reflected light which is usually loss light is reflected forward by the reflection surface 92b.

The emission surfaces 94a of the resin molding 94 is formed in a semisphere to function as a lens, so that radiation is converged there.

Thus, the reflection surface 92b decreases light loss to remove uneven luminance and enables the emission surface 94a to positively condense light.

The light emitting diode of FIG. 15A, 15B has the problem that the diode chip 62 is air-tightly packaged, which requires a number of parts, and its fabrication process is accordingly complicated. Besides the light emitting diode of FIG. 15B needs aligning the optical axis of the diode chip 62 with those of the ball lenses 63, 64, and in welding the cap 65 to the package 61, their positioning needs considerably high precision. The fabrication process is accordingly complicated, and resultantly its fabrication cost goes up.

In the light emitting diode of FIG. 16 as well, considerable precision is required in welding the plastic cap 73 with the lens system to the stem with the diode chip 71 mounted on, and the fabrication process is complicated.

In the light emitting device of FIG. 17 it is necessary to agree with good precision the optical axis of the light emitting diode 81 with the center of the end surface of an optical fiber F for the purpose of enhancing the coupling efficiency in adhering the stepped sleeve 83 with a restricted portion 85 for fixing the optical fiber F. This precision depends on a precision of positioning the stepped sleeve 83 to the stem 82. Accordingly considerable precision is required, which makes the fabrication process of the light emitting device complicated. This has incurred high fabrication costs.

In the light emitting device of FIG. 18 the portion for removing light loss, and the portion for positively condensing radiation are separately constituted. This makes the structure of the device and its fabrication process complicated. When the light emitting diode 93 is die-bonded, the head 92 of the frame 91 providing the reflection surface 92b is heated, adversely making the reflection surface 92b rough, with the result of lowered reflection efficiency.

Reference is also made to CH-A-474201, which discloses an LED in which a reflective surface is provided behind and around the optically active element in order to produce a detailed light output beam.

An object of this invention is to provide an optical device which has a simple structure and is capable of high condensing. In some embodiments, the optical device can be easily coupled with optical fibers, etc. with a required coupling precision.

According to the invention there is provided an optical device comprising a frame, an optical active device mounted on the frame and integrated therewith by a light-transmitting resin molding in which the optical active device is buried,

and two lenses buried in the light-transmitting resin molding facing an active surface of the optical active device and having the same optical axis (L) which is per-

pendicular to the main surface of the optical device and coincides with an optical axis of incident or emitting light of the optical active device.

Two lenses buried in the resin molding facing to the active surface of the optical active device enhance the condensation. These lenses are buried in the resin molding, and consequently the lenses are kept from the outside environmental changes, and are stable against vibrations, etc. The resin molding can easily form the optical active device in arbitrary shapes, while decreasing a number of parts.

One of the lenses positioned on the side of the optical active device may be bonded to the active surface of the optical active device. Consequently there is little possibility that the lens is dislocated in the resin-molding operation, and the molding is easy.

The incidence or emission surface of the resin molding may be formed in a convex surface functioning as a lens. Consequently the incident or the emission light with respect to the optical device can be converged on two stages by the lens buried facing to the optical active surface, and the convex surface formed on the incidence or emission surface of the resin molding. This lens, and the incident or emission surface are resin-molded or provided by resin moldings, and consequently alignment of the optical axes can be easily conducted with high precision. and the whole device can be easily fabricated.

According to the invention there is provided an optical device comprising a frame, an optical active device mounted on the frame and integrated therewith by a light-transmitting resin molding in which the optical active device is buried, and two lenses positioned facing an active surface of the optical active device · and having the same optical axis which is perpendicular to said active surface and coincides with an optical axis of incident or emitting light of the optical active device, one of the lenses being a convex lens portion integrally formed on a surface of the resin molding, and the other of the lenses being a spherical lens buried in the resin molding.

Prefered embodiments of the invention are specified in the dependent claims.

By applying this invention to light emitting devices, photodetecting devices or optical electric integrated circuits, devices providing high condensing and simple structure can be obtained.

The invention will be better understood from the following description given by way of example with reference to the accompanying drawings, wherein:

FIG. 1A is a vertical sectional view of the light emitting diode according to a first embodiment of this invention;
FIG. 1B is a plan view of the light emitting diode according to the first embodiment of this invention;
FIG. 2 is a vertical sectional view of the light emitting diode according to a modification of the first embodiment;
FIG. 3 is a vertical sectional view of the light emitting diode according to a second embodiment of this invention;
FIG. 4 is a vertical sectional view of the light emitting diode according to a third embodiment of this invention;
FIG. 5 is a plan view of the horizontal type light emitting diode according to a fourth embodiment of this invention;
FIG. 6A is a vertical sectional view of the light emitting diode according to a fifth embodiment of this invention;
FIG. 6B is a plan view of the light emitting diode according to a fifth embodiment of this invention;
FIG. 7 is a vertical sectional view of the light emitting diode according to a modification of the fifth embodiment;
FIG. 8 is a plan view of the horizontal type light emitting diode according to a sixth embodiment of this invention;
FIG. 9A is a vertical sectional view of a seventh embodiment of this invention;
FIG. 9B is a plan view of the light emitting diode according to the seventh embodiment;
FIG. 10 is a vertical sectional view of the light emitting diode which is not in accordance with this invention but which is disclosed for the purpose of facilitating an understanding of an eighth embodiment according to Figure 11;
FIG. 11 is a vertical sectional view of the light emitting diode according to the eighth embodiment;
FIG. 12A is a vertical sectional view of a light emitting diode array which is not in accordance with this invention;
FIG. 12B is a sectional view along the line A-A in FIG. 12A;
FIG. 13 is a vertical sectional view of the photodiode according to a ninth embodiment of this invention;
FIG. 14 is a vertical sectional view of the optical electric integrated circuit according to a tenth embodiment of this invention;
FIG. 15A is a vertical sectional view of the light emitting diode using the conventional can-type package;
FIG. 15B is a vertical sectional view of the light emitting diode using the conventional can-type package;
FIG. 16 is a vertical sectional view of the light emitting diode using the conventional plastic package;
FIG. 17 is a vertical sectional view using the conventional LED collimator (light emitting device); and
FIG. 18 is a vertical sectional view of the conventional light emitting diode having the condensation improved.

The light emitting diode according to a first embodiment of this invention will be explained below with reference to FIGs. 1A and 1B.

This light emitting diode 1 comprises a diode chip 3 (optical active device) mounted on a lead frame 2 which are integrated by molding a transparent resin 4 into a cylindrical shape.

The diode chip 3 is die-bonded to the bed portion 5a of a cathode lead 5 and wire-bonded to an anode lead 6 by a wire 7 bridged between the forward end of the anode lead 6 and the same. A first ball lens 8 is positioned so as to have an optical axis which coincides with an optical axis L of an emitting light of the diode chip 3 and adhered to the light emitting surface (active surface) 3a. The first ball lens 8 is buried in the transparent resin molding 4. Diffuse-radiation from the light emitting surface 3a is immediately received by the first ball lens 8 to be collimated into substantially parallel rays.

A second ball lens 9 is buried ahead of the first ball lens 8 so as to have an optical axis which coincides with the optical axis L. The radiation which has been collimated into substantially parallel rays is further converged by the second ball lens 9 to focus immediately ahead of the second ball lens 9. This fully enhances the condensation. A lower half of the second ball lens 9 is buried, and an upper half thereof is exposed. This exposed portion is positioned in a mold to be integrated by the resin molding.

In this embodiment, radiation from the diode chip 3 is collimated into substantially parallel rays by the first ball lens and is focussed by the second ball lens 9. The second ball lens 9 is larger than at least the first ball lens 8. The sizes of both lenses 8, 9 are determined by a size of the diode chip 3, a focal point, etc. The materials of both lenses 8, 9 are preferably transparent materials, especially preferably glass ball lenses, having refractive indexes equal to or higher than 1.7 to 1.9 because the refractive index of the resin molding is 1.5. In this embodiment, taking cost aspect into consideration, TiO_2, BaO_2, SiO_2 based glass ball lenses are suitably used. The refractive indexes of both lenses 8, 9 as well as the sizes thereof can be freely chosen to some extent.

Thus, the radiation is condensed on the two stages respectively by the first and the second ball lenses, and resultantly the light emitting diode 1 can have very high condensation. Consequently it is possible to couple the light emitting diode 1 to optical fibers of small core diameters, etc. with high coupling efficiency. The first ball lens 8 is positioned by the adhesion to the diode chip 3, and the second ball lens 9 is positioned by a mold, whereby the optical axis L can be aligned with high precision. In this embodiment, the diode chip 3 is not packaged by air-tight sealing but by molding the resin. Consequently its fabrication is easy, and the variability of the products can be decreased. In addition, the shape of the light emitting diode 1 can be freely changed in accordance with devices for the light emitting diode to be used, portions of machines and instruments for the diode to be attached to, etc.

FIG. 2 is the light emitting diode according to one modification of the first embodiment. This modification takes the advantage of the fact that the light emitting diode can be resin-molded into a suitable shape, and the light emitting diode according to this modification has a flange 4a formed on the base of the resin molding 4 for facilitating the attachment of the light emitting diode to machines and instruments. The first ball lens 8 is relatively smaller, and the second ball lens is larger. Screw holes or the like are formed in the flange 4a for setting the light emitting diode to machines and instruments.

FIG. 3 shows the light emitting diode according to a second embodiment of this invention. In this light emitting diode 1, a flange 4a is formed as is done in the above-described modification, and a second ball lens 9 is completely buried in a molded resin for the perfect protection of the second ball lens 9 from the outside environments.

FIG. 4 shows the light emitting diode according to a third embodiment of this invention. In this light emitting diode 1, a concave groove 4b for the adhesion of a second ball lens 9 is formed in the emission surface of a resin molding 4. The substantially lower half of the second ball lens 9 is adhered to the concave groove 4b. This not only facilitates the fabrication of the light emitting diode, but also makes it possible to prepare a plurality of ball lenses having the same size but different refractive indexes and replace the second ball lens 9 for later arbitrary adjustment of the focal point, etc.

FIG. 5 shows the light emitting diode according to a fourth embodiment of this invention. This light emitting diode 1 is the so-called horizontal type and is used in machines and instruments whose thickness is limited. A cathode lead 5 and an anode lead 6 are extended in the direction perpendicular to the optical axis L of a diode chip 3, i.e., horizontally, and this light emitting diode can be disposed in relatively narrow positions.

In the above -described embodiments and modification, the lenses are glass ball lenses, but their shapes and materials are not limited to the glass ball lenses. Resin convex lenses or the like may be used. For UV radiation, semiconductor lenses, as of InP, GaAs or others, may be used.

FIGs. 6A and 6B show the light emitting diode according to a fifth embodiment of the optical device of this invention.

This light emitting diode 1 has the same structure as those involved in the first to the fourth embodiments but has the following characteristics. That is, the second ball lenses 9 in the first to the fourth embodiments are replaced by a convex portion which functions as a lens and is formed ahead of a ball lens 8 and having an optical axis which coincides with an optical axis L of an emitting light of a diode chip 3, and at which radiation from the light emitting diode 3 exits. This convex portion 4c is equivalent to a semi-spherical lens. Radiation collimated into substantially parallel rays by the ball lens 8 and further condensed by the convex portion 4c so as to focus immediately ahead of the convex portion 4c.

Thus the condensation is sufficiently enhanced.

In this embodiment, radiation from the diode chip 3 is converted by the ball lens 8 into substantially parallel rays and focussed by the convex portion 4c. To this end the convex portion 4c has a larger diameter than at least the ball lens 8. Both diameters are determined by a size of the diode chip 3, a focal point of the exit light, etc.

In this way, the radiation is condensed on two stages by the ball lens 8 and the convex portion 4c equivalent to a lens. Consequently the light emitting diode 1 can have very high condensation. Accordingly this light emitting diode can be coupled to small-diameter optical fibers with high coupling efficiency. The ball lens 8 is positioned by the adhesion to the diode chip 3, and the convex portion 4c is positioned by a mold. Accordingly the optical axis L can be aligned with high precision.

FIG. 7 shows the light emitting diode according to one modification of the embodiment of FIG. 6. This light emitting diode 1 takes the advantage of the fact that the diode 1 can be resin-molded in any contour and has a flange 4a formed on the base of the resin molding 4 for facilitating the attachment of the light emitting diode to machines and instruments. The ball lens 8 is a relatively small one, and the convex portion 4c is formed very near the ball lens 8. This arrangement can compact the light emitting diode 1 having high concentration.

FIG. 8 shows the light emitting diode according to a sixth embodiment of this invention. This light emitting diode 1 is the so-called horizontal type and is used in machines and instruments whose thickness must be small. A cathode lead 5 and an anode lead 6 are extended in the direction perpendicular to the optical axis L, i.e., horizontally, which allows this light emitting diode to be installed in narrow spaces.

FIGs. 9A and 9B show the light emitting diode according to a seventh embodiment of this invention. In this light emitting diode 1, a ball lens 8 is adhered to a light emitting surface 3a of a diode chip 3 as in the sixth embodiment. In place of the convex portion 4c formed in a semi-sphere in the resin molding 4, a stepped surface 4d as a Fresnel lens is formed. Accordingly the exit portion of the resin molding 4 is not jutted therefrom and functions as a lens.

FIG. 10 shows a light emitting diode which is outside the scope of this invention as defined by the appended claims. This light emitting diode 1 has a unique structure which will be explained below.

A fixation groove 10 for the forward end of an optical fiber F to be inserted in is formed in an exit portion of a resin molding 4 having an optical axis which coincides with an optical axis of an emitting light of the diode chip 3. The forward end of the optical fiber F is fixed in the groove 10 by adhesion. The groove 10 is extended with the bottom thereof positioned short of the forward end of a ball lens 8 to locate the forward end of the optical fiber and the ball lens adjacent to each other as much as possible so that the light which has passed the ball lens 8 is received by the optical fiber little loss. Coupled with the condensation by the ball lens 8, this improves the coupling efficiency of the light emitting diode 1 to the optical fiber F. The entrance 10a of the fixation groove 10 is beveled in a funnel-shape for facilitating the insertion of the optical fiber F.

Thus, the light emitting diode 1 and the fixation groove 10 for the optical fiber F are molded integrate, which facilitates the fabrication of the diode and decreases the variability of the product. In addition, the alignment of an optical axis of an emitting light of the diode chip 3 with the optical axis L of the optical fiber F is automated, which facilitates the coupling of the optical fiber F and improves its coupling efficiency, and the fabrication cost is accordingly decreased. This light emitting diode is useful especially to sensors and optical communication using large-bore fibers, such as plastic fibers or others.

FIG. 11 shows the light emitting diode according to an eighth embodiment, being a modification to the light emitting diode according to Figure 10. In this light emitting diode 1, a convex portion 4c functioning as a lens is formed at an exit 4c ahead of the ball lens 8 so that radiation from the diode chip 3 is condensed on two stages respectively by the ball lens 8 and the convex portion 4c.

In addition, taking the advantage of the fact that the diode 1 can be resin-molded into an arbitrary shape, a flange 4a with screw holes is formed on the resin molding 4 on the side of the exit for easy attachment of the light emitting diode to machines and instruments. A small hole 11 which is in communication with the fixation groove 10 is formed in the side of the molded resin 4 for the communication with the fixation groove 10, and when the optical fiber F is fixed in the groove by adhesion, an adhesive is injected through the small hole 10.

This arrangement produces high condensation and improves coupling efficiency of the optical fiber F. In addition, owing to this arrangement, the light emitting diode can be incorporated in optical communication modules, etc.

In these embodiments and modifications, the lenses are ball glasses, but shapes and materials are not limited to the glass ball lenses. Resin convex lenses or others may be used. The convex portion 4c is not necessarily convex and may be a Fresnel lens as long as the portion has the condensing function.

FIG. 12 shows a light emitting diode array which does not form part of this invention.

This light emitting diode array 21 comprises a plurality (5) of diode chips mounted on a lead frame 2 and molded integral of a transparent resin 4. A ball lens 8 is adhered to the light emitting surface 3a of each of the diode chips 3 so as to have an optical axis which coincides with an optical axis of an emitting light of the diode chip, and the thus-adhered ball lenses 8 are buried in a resin molding 4.

In the resin molding 4 on the side of exits there is embedded a groove forming chip 22 having a plurality

of fixation grooves 10 corresponding to the diode chips 3. The groove forming chip 22 is made of a semiconductor and comprises a Si substrate 23 having V-shaped grooves 23a formed therein, and a plate 24 adhered to the substrate so as to close the V-shaped grooves 23a. Accordingly the fixation grooves 10 have regular triangular section and the centers of the respective fixation grooves are in alignment with the optical axes of emitting lights of their associated diode chips 3.

Thus, when an optical fiber F is inserted into each of the fixation grooves 10, the optical fiber F of circular section is contact-supported at three points in the fixation groove of regular triangular section, which makes it possible to align their optical axes accurately.

In the above-described embodiments, the optical device is light emitting diodes, but it is needless to say that the optical device according to this invention is applicable to light detecting devices, such as photo-diodes and others, or optical electric integrated circuits (OEIC) integrating these optical positive devices and electric devices,such as amplifiers, drivers, FETs, etc.

FIG. 13 shows a photo-diode involved in a ninth embodiment of the optical positive device according to this invention. This photo-diode 41 comprises a diode chip (optical active device) 43 mounted on a lead frame 42 which are molded of a transparent resin 4 to be integral in a cylindrical shape.

A diode chip 43 is die-bonded to the bed 45a of a cathode lead 45 and wire-bonded with the forward end 46 of an anode lead 46 by a wire 47. A first ball lens 48 is adhered to the photodetecting surface 43 (active surface) of the diode chip 43 on the same optical axis L as the diode chip 43. In this state the first ball lens 48 is buried in a resin molding 44.

In the resin molding 44 a second ball lens 49 as well is buried before the first ball lens 48 so as to have an optical axis which coincides with an optical axis L of an emitting light of the diode chip 43. Radiation entering from the outside is led from an entrance of the resin molding 44 to be condensed here, and further condensed by the first ball lens 48 to focus on the photodetecting surface 43a of the diode chip 43.

The material of both ball lenses 48, 49 in this embodiment is a transparent material having a refractive index equal to or higher than 1.7 to 1.9, taking it into consideration that the refractive index of the resin molding 44 is 1.5, and especially glass ball lenses are preferable. In this embodiment, taking cost aspect into account, TiO_2, BaO_2 and SiO_2 based glass ball lenses are selectively used. The refractive indexes of both lenses 48, 49 as well as their sizes can be selected freely to some extent.

Thus, the incident light can be condensed on two stages by the first ball lens 48 and the second ball lens 49, and consequently the photodiode 41 can have very high condensation efficiency.

FIG. 14 shows the optical electric integrated circuit according to a tenth embodiment of the optical device of this invention. This optical electric integrated circuit 51 comprises a substrate 54, a photodetecting region 52 and a signal processing circuit region 53 which are integrally molded of a transparent resin.

In the photodetecting region 52, GaAs doped by Er is crystal-grown as a buried light absorption layer 52a. On the light absorption layer 52a there are formed a pair of electrodes 52b, 52b for taking out signals. In the signal processing circuit 53 there are formed a contact region 53a and active layers 52b, 53b, and electrodes 53c, 53c, 53c thereon. The electrodes 53c, 53c, 53c are a source electrode, a gate electrode and a drain electrode, and function as circuit elements for signal processing to constitute a FET.

A first ball lens 56 is adhered to the surface of the light absorption layer of the photodetecting region 52 so as to have an optical axis which coincides with an optical axis of an emission light from the light absorption layer 52. In thus adhered state the first ball lens 56 is buried in a molded resin 55.

A second ball lens 57 is also buried in the resin molding before the first ball lens 56 so as to have an optical axis which coincides with an optical axis of an emitting light from the light absorption layer. The radiation from the outside is led from the entrance of the molded resin 55 to the second ball lens 57 to be condensed here and further condensed by the first ball lens 56 to focus on the surface of the light absorption layer 52. Here the radiation is photoelectrically converted and then is processed, e.g., amplified, etc. in the signal processing circuit region 53.

Thus the incident light is condensed on two stages by the first and the second ball lenses 56, 57, and consequently the optical electric integrated circuit can have very high condensation efficiency and can be compact.

Claims

1. An optical device comprising a frame (2), an optical active device (3) mounted on the frame (2) and integrated therewith by a light-transmitting resin molding (4) in which the optical active device (3) is buried, and two lenses (8, 9) buried in the light-transmitting resin molding (4) facing an active surface of the optical active device (3) and having the same optical axis (L) which is perpendicular to the main surface of the optical device and coincides with an optical axis of incident or emitting light of the optical active device (3).

2. An optical device according to claim 1, wherein at least one of the lenses is secured by bonding to the active surface of the optical active device.

3. An optical device according to claim 1, wherein incidence or emission surface of the resin molding is formed in convex surfaces functioning as said lens-

es.

4. An optical device comprising a frame (2) an optical active device (3) mounted on the frame (2) and integrated therewith by a light-transmitting resin molding (4) in which the optical active device is buried, and two lenses positioned facing an active surface of the optical active device (3) and having the same optical axis which is perpendicular to said active surface and coincides with an optical axis of incident or emitting light of the optical active device, one of the lenses (4c, 4d) being a convex lens portion integrally formed on a surface of the resin molding, and the other of the lenses being a spherical lens (8) buried in the resin molding.

5. An optical device according to claim 1 or 4, wherein the lenses are spherical lenses.

6. An optical device according to claim5, wherein the lenses are ball lenses.

7. An optical device according to claim 1, wherein the lenses are non-spherical lenses.

8. An optical device according to claim 1, wherein refractive indexes of the lenses are higher than the refractive index of the resin molding.

9. An optical device according to claim 1 or 4, wherein the lenses are glass lenses.

10. An optical device according to claim 9, wherein the glass lenses are made of TiO_2 glass, BaO_2 glass or SiO_2 glass as main components.

11. An optical device according to claim 1 or 4, wherein the lenses are a light-transmitting semiconductor.

12. An optical device according to claim 11, wherein the semiconductor device comprises InP or GaAs as a main component.

13. An optical device according to claim 3, wherein the entrance and exit surface are spherical.

14. An optical device according to claim 4, wherein the entrance and exit surface are formed in stepped surfaces as Fresnel lenses.

15. An optical device according to claims 1, wherein an attachment flange is formed on a part of the resin molding.

16. An optical device according to claims 1, wherein the optical active device is a light emitting device.

17. An optical device according to claims 1, wherein the optical active device is a photodetecting device.

18. An optical device according to claims 1, wherein the optical active device is an optical electric integrated circuit.

19. An optical device according to claim 4, wherein refractive indexes of the lenses are higher than the refractive index of the resin molding.

Patentansprüche

1. Eine optische Einrichtung, umfassend einen Rahmen (2), eine optische aktive Einrichtung (3), die auf dem Rahmen (2) angebracht und damit durch eine lichtübertragende Harzformung (4), in die die optisch aktive Einrichtung (3) vergraben ist, integriert ist, und zwei Linsen (8, 9), die in der lichtübertragenden Harzformung (4) auf eine aktive Oberfläche der optischen aktiven Einrichtung (3) hin gerichtet vergraben sind und die gleiche optische Achse (L) aufweisen, die senkrecht zu der Hauptoberfläche der optischen Einrichtung ist und mit einer optischen Achse eines einfallenden oder emittierenden Lichts der optischen aktiven Einrichtung (3) übereinstimmt.

2. Optische Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß wenigstens eine Linse der Linsen durch Bondung an der aktiven Oberfläche der optischen aktiven Einrichtung gesichert ist.

3. Optische Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß eine Einfalls- oder Emissionsoberfläche der Harzformung in konvexen Oberflächen, die als die Linsen dienen, ausgebildet ist.

4. Optische Einrichtung, umfassend einen Rahmen (2), eine optische aktive Einrichtung (3), die auf dem Rahmen (2) angebracht und damit durch eine lichtübertragende Harzformung (4), in der die optische aktive Einrichtung vergraben ist, integriert ist, und zwei Linsen, die auf eine aktive Oberfläche der optischen Einrichtung (3) hin gerichtet positioniert sind und die gleiche optische Achse aufweisen, die senkrecht zu der aktiven Oberfläche ist und mit einer optischen Achse eines einfallenden oder emittierenden Lichts der optischen aktiven Einrichtung übereinstimmt, wobei eine der Linsen (4c, 4d) ein konvexer Linsenabschnitt ist, der integral auf einer Oberfläche der Harzformung gebildet ist, und die andere der Linsen eine sphärische Linse (8) ist, die in der Harzformung vergraben ist.

5. Optische Einrichtung nach Anspruch 1 oder 4, dadurch gekennzeichnet, daß die Linsen sphärische Linsen sind.

6. Optische Einrichtung nach Anspruch 5, dadurch gekennzeichnet, daß die Linsen Kugellinsen sind.

7. Optische Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Linsen nicht-sphärische Linsen sind.

8. Optische Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß Brechungsindizes der Linsen höher als der Brechungsindex der Harzformung sind.

9. Optische Einrichtung nach Anspruch 1 oder 4, dadurch gekennzeichnet, daß die Linsen Glaslinsen sind.

10. Optische Einrichtung nach Anspruch 9, dadurch gekennzeichnet, daß die Glaslinsen aus einem TiO_2-Glas, einem BaO_2-Glas oder einem SiO_2-Glas als Hauptkomponenten gebildet sind.

11. Optische Einrichtung nach Anspruch 1 oder 4, dadurch gekennzeichnet, daß die Linsen ein lichtübertragender Halbleiter sind.

12. Optische Einrichtung nach Anspruch 11, dadurch gekennzeichnet, daß die optische Einrichtung InP oder GaAs als eine Hauptkomponente umfaßt.

13. Optische Einrichtung nach Anspruch 3, dadurch gekennzeichnet, daß die Eintritts- und Austrittsoberfläche sphärisch sind.

14. Optische Einrichtung nach Anspruch 4, dadurch gekennzeichnet, daß die Eintritts- und Austrittsoberfläche in gestuften Oberflächen als Fresnel-Linsen ausgebildet sind.

15. Optische Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß ein Befestigungsflansch auf einem Teil der Harzformung gebildet ist.

16. Optische Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die optische aktive Einrichtung eine Leuchtdiode ist.

17. Optische Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die optische aktive Einrichtung eine fotodetektierende Einrichtung ist.

18. Optische Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die optische aktive Einrichtung eine optische elektrische integrierte Schaltung ist.

19. Optische Einrichtung nach Anspruch 4, dadurch gekennzeichnet, daß die Brechungsindizes der Linsen höher als der Brechungsindex der Harzformung sind.

Revendications

1. Dispositif optique comprenant un support (2), un dispositif optique actif (3) monté sur le support (2) et intégré à celui-ci grâce à un moulage de résine transmettant la lumière (4) dans lequel le dispositif optique actif (3) est noyé, et deux lentilles (8, 9) noyées dans le moulage de résine transmettant la lumière (4) faisant face à une surface active du dispositif optique actif (3) est présentant le même axe optique (L) qui est perpendiculaire à la surface principale du dispositif optique et coïncide avec un axe optique de la lumière incidente ou d'émission du dispositif optique actif (3).

2. Dispositif optique selon la revendication 1, dans lequel au moins l'une des lentilles est fixée par collage à la surface active du dispositif optique actif.

3. Dispositif optique selon la revendication 1, dans lequel la surface d'incidence ou d'émission du moulage de résine est formée suivant des surfaces convexes agissant en tant que lesdites lentilles.

4. Dispositif optique comprenant un support (2), un dispositif optique actif (3) monté sur le support (2) et intégré à celui-ci par un moulage de résine transmettant la lumière (4) dans lequel le dispositif optique actif (3) est noyé, et deux lentilles positionnées à l'opposé d'une surface active du dispositif optique actif (3) et présentant le même axe optique qui est perpendiculaire à ladite surface active et coïncide avec un axe optique de la lumière incidente ou d'émission du dispositif optique actif, l'une des lentilles (4c, 4d) étant une partie de lentille convexe formée de façon intégrée sur une surface de moulage de résine, et l'autre des lentilles étant une lentille sphérique (8) noyée dans le moulage de résine.

5. Dispositif optique selon la revendication 1 ou 4, dans lequel les lentilles sont des lentilles sphériques.

6. Dispositif optique selon la revendication 5, dans lequel les lentilles sont des lentilles en bille.

7. Dispositif optique selon la revendication 1, dans lequel les lentilles sont des lentilles non sphériques.

8. Dispositif optique selon la revendication 1, dans lequel les indices de réfraction des lentilles sont plus élevés que l'indice de réfraction du moulage de résine.

9. Dispositif optique selon la revendication 1 ou 4, dans lequel les lentilles sont des lentilles de verre.

10. Dispositif optique selon la revendication 9, dans le-

quel les lentilles de verre sont faites d'un verre de TiO_2, d'un verre de BaO_2 ou d'un verre de SiO_2 en tant que composants principaux.

11. Dispositif optique selon la revendication 1 ou 4, dans lequel les lentilles sont faites d'un semiconducteur transmettant la lumière.

12. Dispositif optique selon la revendication 11, dans lequel le dispositif de semiconducteur comprend InP ou GaAs en tant que composant principal.

13. Dispositif optique selon la revendication 3, dans lequel les surfaces d'entrée et de sortie sont sphériques.

14. Dispositif optique selon la revendication 4, dans lequel les surfaces d'entrée et de sortie sont formées en surfaces échelonnées en tant que lentilles de Fresnel.

15. Dispositif optique selon la revendication 1, dans lequel une bride de fixation est formée sur une partie du moulage de résine.

16. Dispositif optique selon la revendication 1, dans lequel le dispositif optique actif est un dispositif d'émission de lumière.

17. Dispositif optique selon la revendication 1, dans lequel le dispositif optique actif est un dispositif de photodétection.

18. Dispositif optique selon la revendication 1, dans lequel le dispositif optique actif est un circuit intégré opto-électrique.

19. Dispositif optique selon la revendication 4, dans lequel les indices de réfraction des lentilles sont plus élevés que l'indice de réfraction du moulage de résine.

Fig. 1A

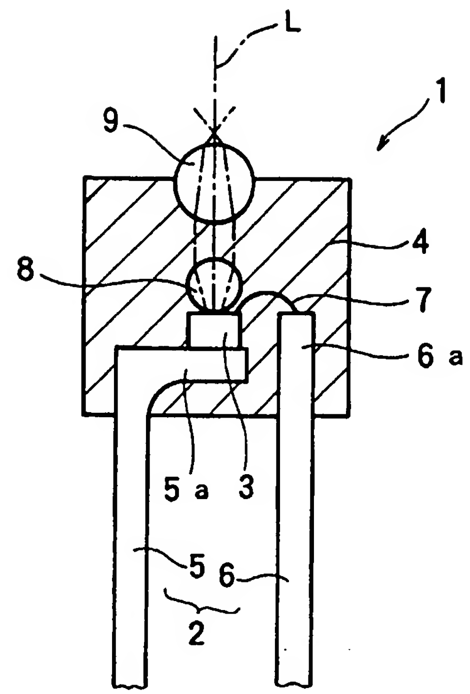

Fig. 1B

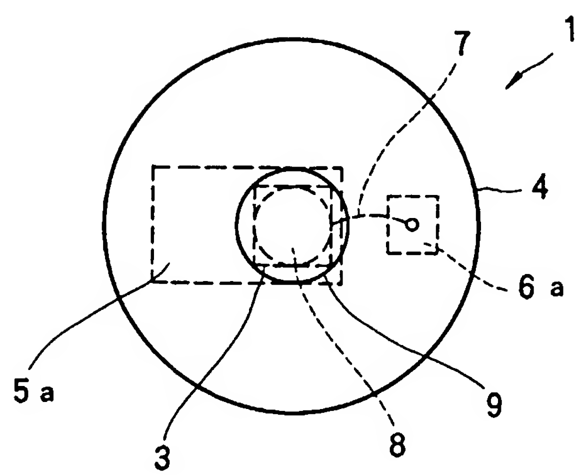

Fig. 2

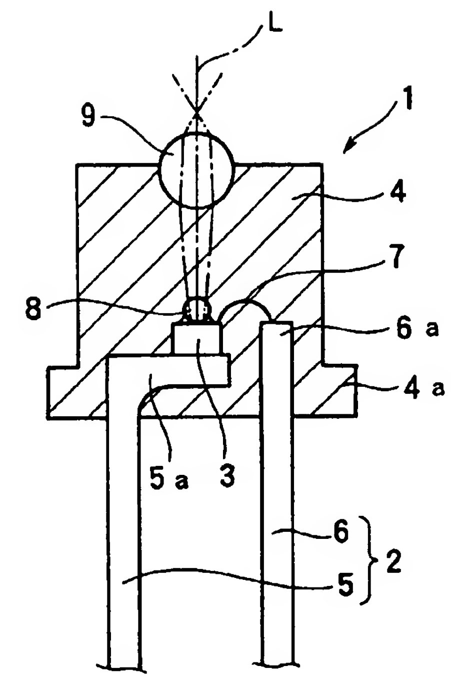

Fig. 3

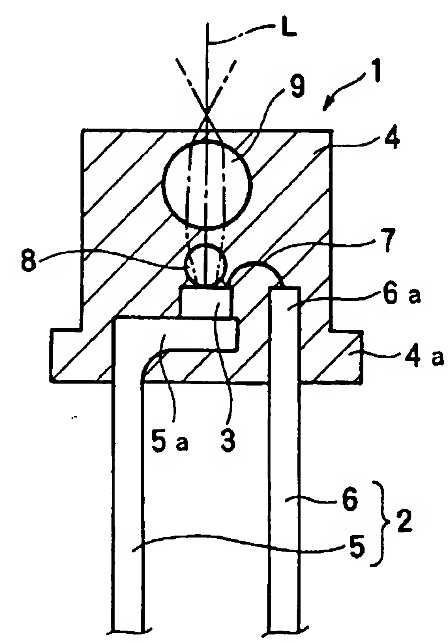

Fig. 4

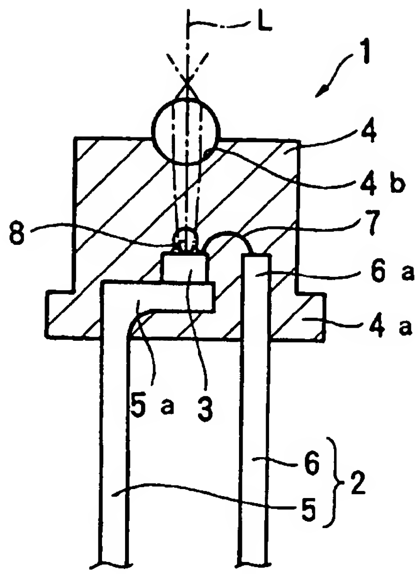

Fig. 5

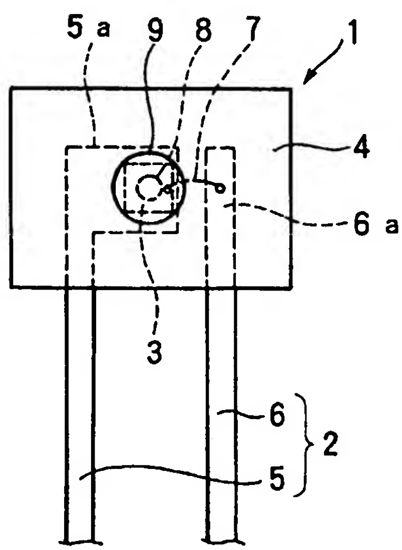

Fig. 6A

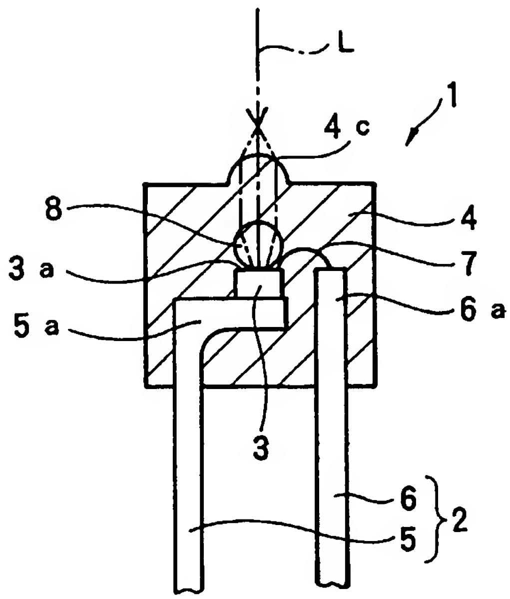

Fig. 6B

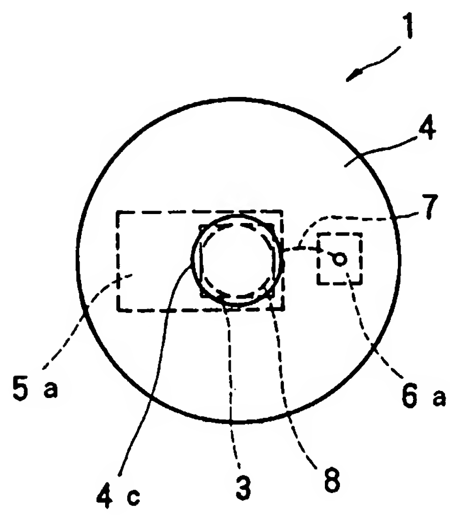

Fig. 7

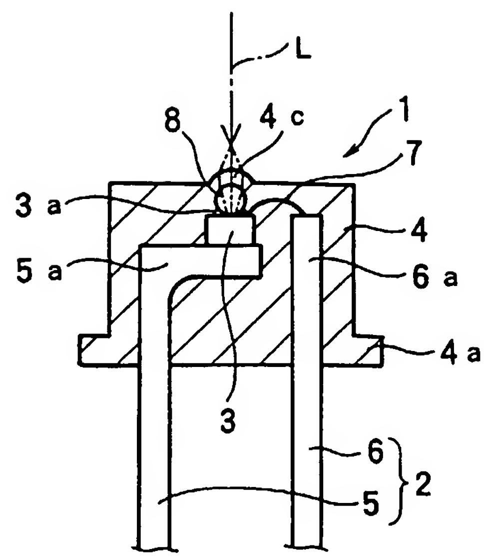

Fig. 8

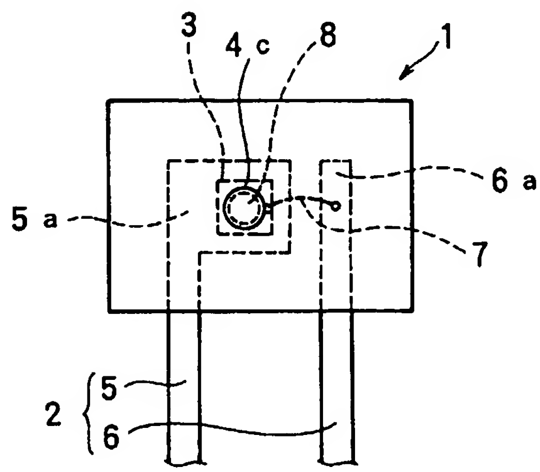

Fig. 9A

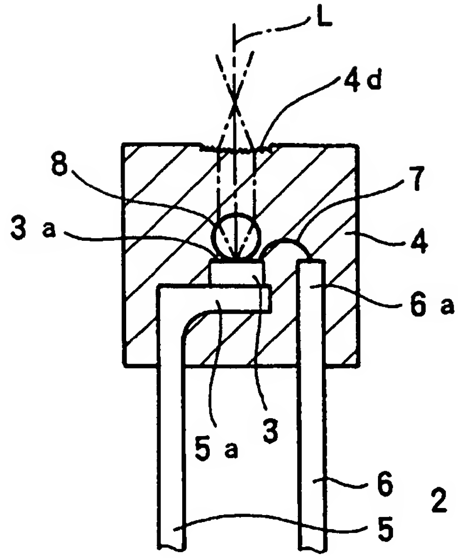

Fig. 9B

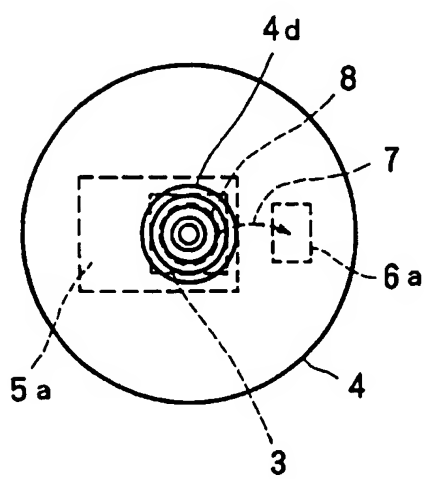

Fig. 10

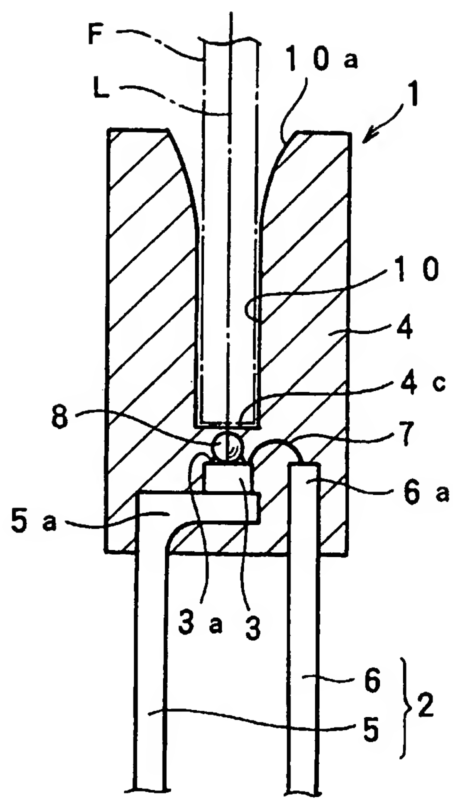

Fig. 11

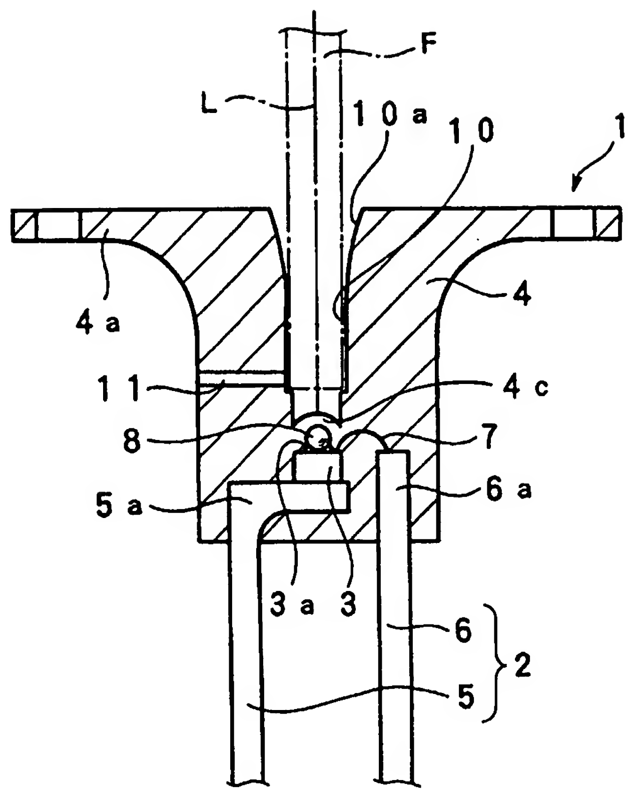

Fig. 12A

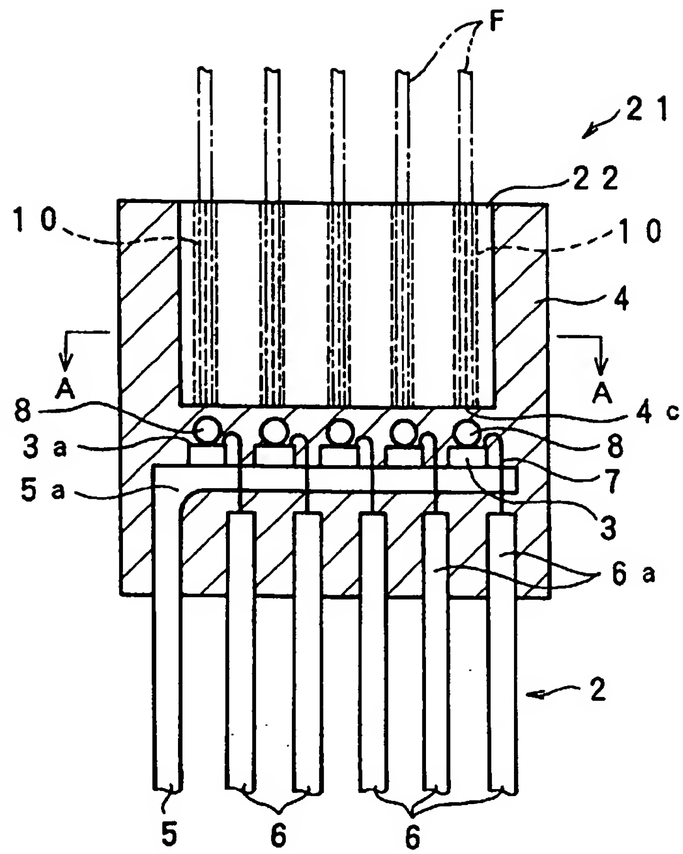

Fig. 12B

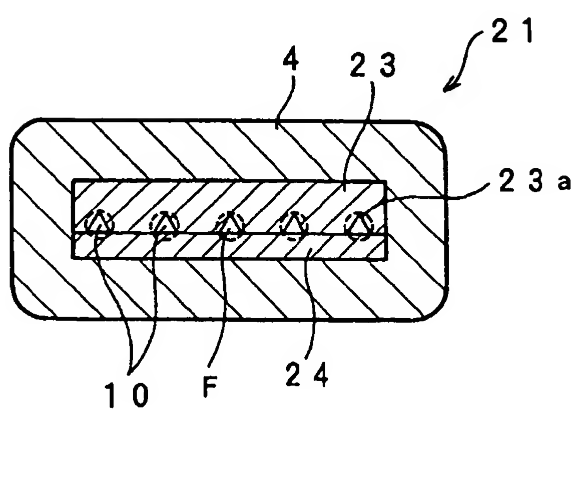

Fig. 13

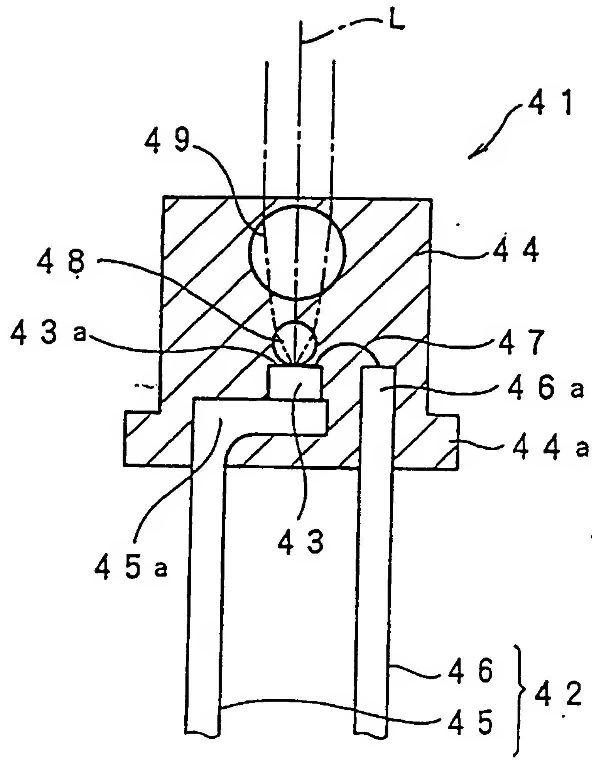

Fig. 14

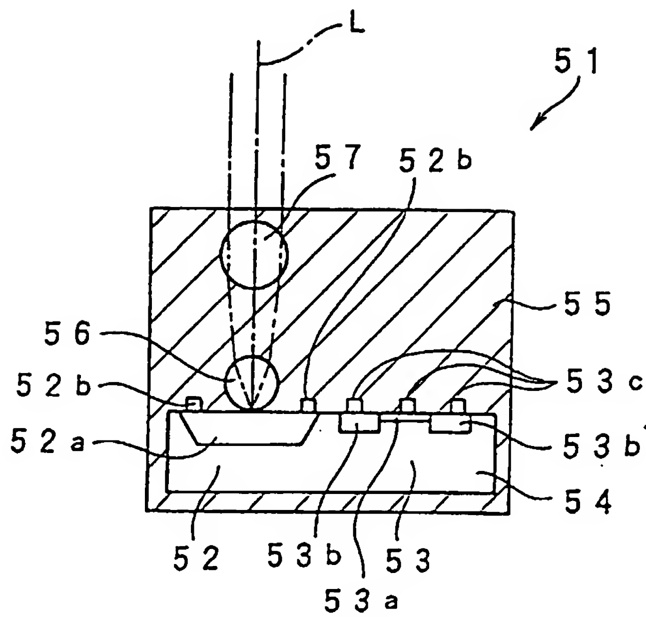

Fig. 15A

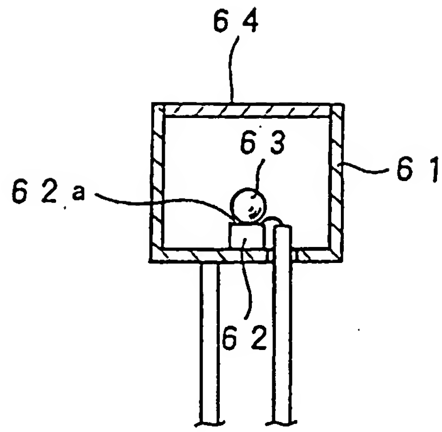

Fig. 15 B

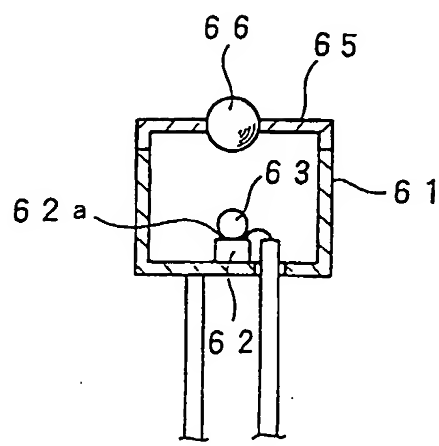

Fig. 16

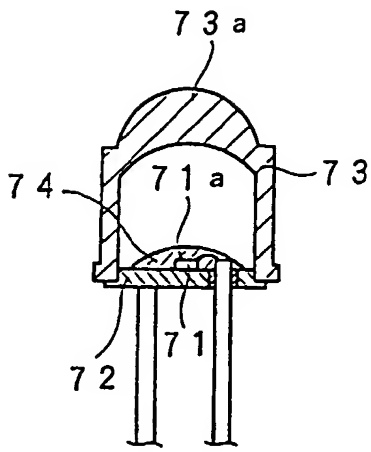

Fig. 17

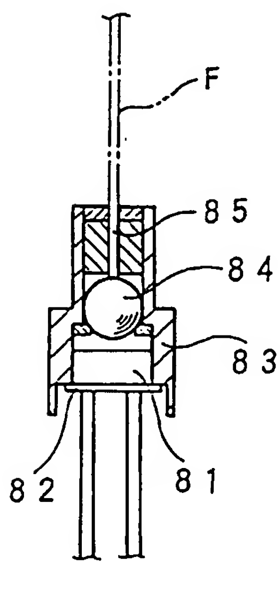

Fig. 18